MODELING AND FORECASTING COMPLEX ENVIRONMENTAL SITUATIONS ON THE EXAMPLE OF THE CHERKASY REGION

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МОДЕЛЮВАННЯ ТА ПРОГНОЗУВАННЯ КОМПЛЕКСНИХ ЕКОЛОГІЧНИХ СИТУАЦІЙ НА ПРИКЛАДІ ЧЕРКАСЬКОЇ ОБЛАСТІ

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МОДЕЛИРОВАНИЕ И ПРОГНОЗИРОВАНИЕ КОМПЛЕКСНЫХ ЭКОЛОГИЧЕСКИХ СИТУАЦИЙ НА ПРИМЕРЕ ЧЕРКАССКОЙ ОБЛАСТИ

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The increase in anthropogenic pressure on the environment requires an integrated approach to decision-making in order to control and predict its pollution. The influence of many factors that can have a significant impact and large amounts of information that must be considered in the decision-making process should be taken into account. Therefore, the creation of methods and software tools for processing all the available information and giving reasonable recommendations for making effective decisions, especially in an environmentally unfriendly region such as the Cherkasy region, is an urgent task.

***Keywords**: anthropogenic pressure; computer system; forecasting and control*

Збільшення антропогенного тиску на навколишнє середовище вимагає комплексного підходу до прийняття рішень з метою контролю та прогнозування його забруднення. Слід брати до уваги вплив багатьох факторів, які можуть мати значний вплив, і велика кількість інформації, яку необхідно враховувати в процесі прийняття рішень. Тому актуальним завданням є створення методів та програмних засобів для обробки всієї наявної інформації та надання обґрунтованих рекомендацій для прийняття ефективних рішень, особливо в екологічно несприятливому регіоні, наприклад, у Черкаській області.

***Ключові слова:** антропогенний тиск; комп'ютерна система; прогнозування та контроль*

Повышение антропогенной нагрузки на окружающую среду требует комплексного подхода к принятию решений с целью контроля и прогнозирования ее загрязнения. Влияние многих факторов, которые могут оказать значительное влияние, и большое количество информации, которая должна учитываться в процессе принятия решений, должны быть приняты во внимание. Поэтому создание методов и программных средств для обработки всей доступной информации и предоставления разумных рекомендаций для принятия эффективных решений, особенно в экологически неблагоприятном регионе, таком как Черкасская область, является актуальной задачей.

***Ключевые слова:** антропогенное давление; компьютерная система; прогнозирование и контроль*

In conditions of increased anthropogenic pollution of the territory of Ukraine, the research and forecasting of complex environmental situations by methods of mathematical modeling and multivariate statistical analysis, realized in software tools and modern methods of computer data visualization are relevant. Due to the lack of such comprehensive tools, there is a need for the development of scientific methods for the study of integrated assessments and forecasts of the impact of man-made pressures on the environment and human beings, and the creation of specialized systems for data analysis of medical and environmental monitoring, designed to collect, store and process information using modern GIS technologies. A comprehensive approach to environmental management allows to realize economic and environmental interests of a human no in contradiction, but in interaction with each other [1,2].

Therefore, the development of methods for forecasting, control and comprehensive assessment of the impact of man-made loads on the environmental state of the environment and health of the population of the region; creation of an analytical computer system for systematization, control, analysis and interpretation of medical-ecological monitoring data on the example of Cherkasy region is important.

To achieve this goal, the following main tasks were set and solved:

– to develop a method for systematization, complex assessment, forecasting and control of the impact of man-made loads (in particular radiation exposure) on the state of the environment and health of the population of selected regions;

– to develop a specialized computer system for the analysis and visual interpretation of data of medical and ecological and food monitoring, which would include a database, means of graphical representation of information, software tasks of ecological and cartographic modeling of technogenic pollution;

– to improve the mathematical model of the ICRP for the migration of radionuclides by ecological and trophic chains: to introduce into the model additional blocks for prediction of effective equivalent doses of radiation of the population taking into account the specificity of the diet of the population of Cherkassy region;

– to develop a comprehensive analysis of monitoring data of Cherkasy region with the help of developed algorithmic and software tools, to carry out the zoning of contaminated areas according to radio ecological indicators, to investigate the correlation between levels of pollution and morbidity in selected areas. The analysis results are presented in the form of thematic maps.

Scientific approaches, methods and software considerably simplify the analysis of heterogeneous data, provide a forecast of environmental and environmental changes in time and space and can be used to support the adoption of environmentally sound management decisions in emergency situations.

The obtained results are important, as they greatly expand the knowledge about biological efficiency of the influence of radiological contamination on human vital activity. The results of the research can be used in ecological practice, scientific activity and in the systems of state consumer standard, veterinary service, sanitary and epidemiological services and state inspections, as well as in the teaching of the theoretical disciplines "Ecology", "Radioecology", "Sanitary Hygiene" at universities.

For the development of the database of medical-ecological and food monitoring in the Cherkasy region, Microsoft Access was used, which is a relational-type desktop database. The advantage of Access is a very simple graphical user interface, easy to use, popularity among users, and its files are simply exported to different software packages.

Data for this base were taken from the radiological laboratory of the Center for Testing of Food Products and Industrial Raw Materials, State Enterprise "CherkasyStandardmetrology", where the radiochemical method for analyzing the determination of bioindicators (storage units) of radionuclides in food products was first developed and implemented [3-9].

The following blocks are included in this database):

1. Cartographic materials (terrain terrain, water network).
2. Pollution of the atmosphere (stationary sources, motor transport).
3. Health condition of the population (morbidity, fertility, mortality).
4. Food contamination (137Cs, 90Sr, diet).
5. Soil contamination by radionuclides 137Cs and 90Sr (types of soils, migration coefficients).

MapInfo Professional GIS was used to visualize the data on the map. In Fig. 1 shows the linking of the database data to the previously done digitization of the disbound area, the result of which is listed.

SUMMARY

1. Proposed and developed a method for a comprehensive assessment of the human environment, which includes the generalized indicator of air pollution from stationary sources and the integral indicator of radiation contamination of food products.

2. Evaluation method is implemented in the specialized system, which is created for the analysis and visualization of the data of medical-ecological monitoring, control and prediction of levels of technogenic action (atmospheric, food), calculation of doses of radiation radiation. The system is adapted for the Cherkasy region and includes a database of consolidated data of medical and ecological and food monitoring in selected areas of this region.

3. Improved and expanded mathematical model of radionuclide migration (137Cs and 90Sr) by ecological and trophic chains: an additional chamber block for prediction of internal radiation doses has been developed taking into account the specifics of the diet.

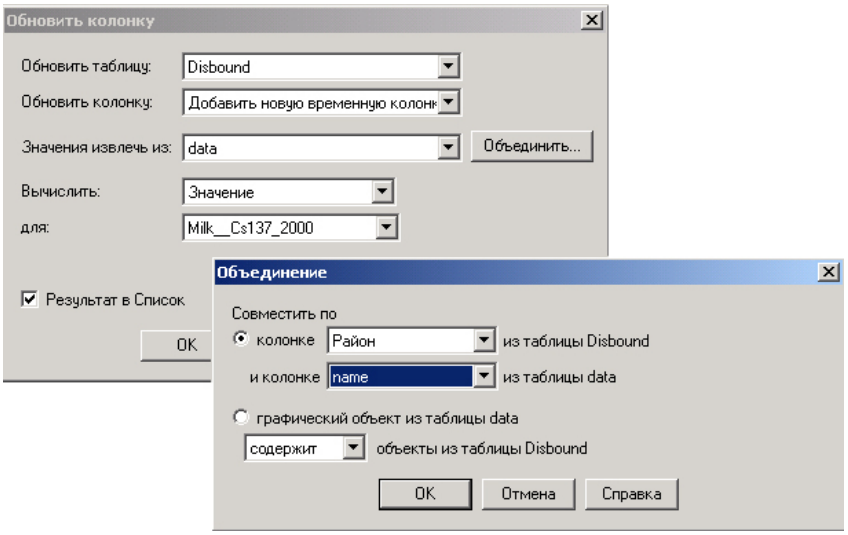

Fig. 1. Data binding for content 137Cs in dairy products table data to digitized table disbound

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